The Influence of Fungicides on the Severity of Mature Watermelon Vine Decline in the Greenhouse and the Field.

One of the conclusions of the last section on greenhouse experiments was that mature watermelon vine decline is likely caused by a soil fungus (fungi) that attack the roots of watermelon plants under the proper environmental conditions. Knowing what soil fungus (fungi) is involved in MWVD is important in beginning to manage the disease. This section describes greenhouse and field experiments in which several different fungicides were used on watermelon plants in an effort to learn if any one of these chemicals could lessen the severity of MWVD. Such knowledge could be valuable in lessening the impact of MWVD for commercial watermelon growers. In addition, since different fungicides affect different kinds of fungi, this research could provide information about what class of fungus (fungi) are responsible for causing MWVD.

Materials and Methods

Effects of Fungicide

Greenhouse experiments. Two greenhouse experiments were conducted in fall/spring of 2001-2002 to study the effects of fungicides applied as root dip to control MWVD. The following fungicides along with untreated control were evaluated: 1) Aliette 80 WDG at 2.3 kg/ha of active ingredient, 2) Rovral 50% at 2.5 kg/ha of active ingredient, 3) Benlate SP 50% at 1.4 kg/ha of active ingredient, 4) Subdue Maxx at 0.07 kg/ha of active ingredient. Seedlings (2 to 3 leaf stage) of watermelon (cv. Royal Sweet) and muskmelon (cv. Eclipse) were immersed in the respective fungicides for 30 minutes before transplanting into 4-L pots (3 seedlings/pot) filled with problem soil obtained from watermelon fields with a history of MWVD. The treatments were arranged in completely randomized design with three replications. Experiments were terminated five weeks after transplanting. Data on plant wilt, crown rot and root rot severity (as previously described) were taken at the conclusion of the experiments. In addition to disease rating, two crown and root segments (~ 0.2 cm)/plant were surface sterilized in 0.5% sodium hypochlorite, rinsed twice in sterilized distilled water, and plated onto P_{10} VP medium and PDAS medium, respectively, to monitor for *Pythiaceous* fungi and general fungi following 2 to 3 day incubation at $25 \pm 2\ ^{o}$ C in dark.

Data analysis. Data were subjected to analysis of variance in CRD with SAS General Linear Models Procedure. Fisher's least significant difference test (P = 0.05) was used to differentiate the treatment means.

Field experiments. Two field experiments were conducted to evaluate fungicides for control of MWVD during the growing seasons of 2001 and 2002 in a loamy sand soil application methods. The following were the root dip rates for the different fungicides: 1) Aliette 80 WDG @ 2.3 kg/ha, 2) Rovral 50% @ 2.5 kg/ha, 3) Benlate SP 50% @ 1.4 kg/ha, and 4) control (no fungicide), and spray application rates were: 1) Aliette 80 WDG @ 4.5 kg/ha, 2) Rovral 50% @ 1.7 kg/ha, 3) Benlate SP 50% @ 2.3 kg/ha, and 4) control (no fungicide). All fungicides were supplemented with 5 ml/3.78 L of water of Activator (surfactant). Watermelon seedlings of a hybrid cultivar 'Summer Flavor 800' were transplanted at 1.1 m apart for a total of 14 plants/plot. The experiment was arranged in a randomized complete block design (RCBD) with four replications.

At the conclusion of the experiment, plant stand was taken; plots were scored for vine health (as previously described), and three plants/replication was scored for crown rot and root rot (as previously explained). Following disease observations, five crown and root segments (~ 0.2 cm)/plant were surface sterilized in 0.5% sodium hypochlorite, rinsed twice in sterilized distilled water, and plated onto P_{10} VP medium (Singleton et al.) and PDAS to monitor for *Pythiaceous* fungi and general fungi following 2 to 3 day incubation at $25 \pm 2\ ^{o}$ C. Marketable fruit number and marketable fruit weight also were recorded at the end of the experiment.

Data analysis. Data were subjected to analysis of variance in RCBD with SAS General Linear Models Procedure. Fisher's least significant difference test ($P = 0.05$) was used to differentiate the effects of fungicides, methods of fungicide application, and mulch on disease variables.

Results

Although plants in the greenhouse experiments did not exhibit wilts symptoms typical of MWVD, root and crown necrosis was observed in both experiments. In experiment one, conducted in the fall of 2000, muskmelon produced significantly more vine length and shoot dry weight than watermelon (Table 1). Muskmelon may have outgrown watermelon due to the root and crown rot observed on watermelon roots.

Benomyl and ipridione fungicides caused some phtotoxiicity on both greenhouse experiments. This may account for observed low vine growth for these two chemicals (Table 1). However, these chemicals also were associated with low amounts of root and crown rots (Table 1).

Fosetyl-Al was associated with the highest vine length and shoot dry weight. Root and crown rots were of a similar level to the controls (Table 1). Metalaxyl had much les top growth but also less root and crown rot.

Little root rot was observed on watermelon plants in the second greenhouse experiment, perhaps because this experiment was conducted in January and February of significantly healthier when sprayed or treated with a root dip plus spraying than the untreated.

Although mulching did not seem to affect root rot severity, those plants on bare ground had more crown rot than mulched plants. In addition, mulch was associated with higher yields in numbers of fruit and weight.

Few symptoms of MWVD were observed in the second field experiment in the summer of 2002, probably due to the dry weather (Table 4). In 2002, mulch was associated with increased number of fruit but not a significant jump in the fruit weight per acre.

Table 1: Greenhouse experiment 1: the influence of different fungicides on the severity of mature watermelon vine decline in muskmelon and watermelon.

Source	**Vine Length (cm)**	**Root Rot**	**Crown rot**	**Shoot Dry Weight (g)**
Crop				
Watermelon	48.8b	1.0a	2.1a	4.8b
Muskmelon	57.9b	0.02b	0.02b	6.8a
Fungicide				
Control	53.9b	0.7a	1.8a	4.8b
Fosetyl-Al	74.9a	0.6a	1.4a	7.6a
Metalaxyl	49.0bc	0.5ab	1.1b	5.7b
Benomyl	46.5bc	0.3b	0.3b	5.7b
Ipridione	42.4c	0.4ab	0.5c	4.7b

Table 2: : Greenhouse experiment 1: the influence of different fungicides on the severity of mature watermelon vine decline in muskmelon and watermelon.

Source	**Vine Length (cm)**	**Root Rot**	**Crown rot**	**Shoot Dry Weight (g)**
Crop				
Watermelon	65.2a	0.5a	0.7a	9.2a
Muskmelon	47.7b	0.02b	0.02b	8.9a
Fungicide				
Control	51.7ab	0.7a	1.0a	9.3ab
Fosetyl-Al	57.2a	0.3b	0.3b	8.1b
Metalaxyl	66.5a	0.1c	0.1c	8.7ab

Table 3. Effects of application methods of the fungicide fosetyl-Al, mulch and their interactions on vine health, plant stand, marketable fruit number, marketable fruit weight, root rot, and crown rot in a field affected by mater watermelon vine decline in 2001.

Factors	**Vine Health***	**Plant Stand # ha^{-1}**	**Marketable Fruit Number ha^{-1}**	**Marketable Fruit Weight Kg ha^{-1}**	**Root Rot Index****	**Crown Rot Index****
Application Methods						
Control	3.3 a***	2723 a	1271 a	19874 a	3.0 a	2.0 a
Root Dip (RD)	2.9 ab	2904 a	1316 a	20023 a	2.2 b	1.7 ab
Spray (S)	2.4 b	3086 a	1497 a	22279 a	1.8 b	1.1 b
RD + S	2.4 b	2360 a	1134 a	17583 a	2.1 b	1.1 b
Mulching						
Mulch	3.2 a	2881 a	1883 a	29051 a	2.3 a	1.1 b
No Mulch	2.3 b	2904 a	726 b	10788 b	2.3 a	1.9 a

* Vine health scored on a 0 to 5 relative scale where 0 – no vine death and 5 = greater than 81% of the vines dead.

** Crown and root rot scored on 0 to 5 relative scale where 0 = no crown or root rot and 5 = greater than 81% crown or root rotted.

*** Values followed by different letter within each factor is significantly different at $P = 0.05$ according to Fisher's Least Significant Test.

Table 4. Influence of fungicides and mulching on vine health, vine length, plant stand, crown rot, root rot, marketable fruit number, and marketable fruit yield in fields affected by mature watermelon vine decline in 2002.

Factors	**Vine Health** *	**Vine Length (cm)**	**Plant Stand # ha^{-1}**	**Crown Rot** **	**Root Rot** **	**Marketable Fruit Number ha^{-1}**	**Marketable Fruit Weight kg ha^{-1}**
Fungicides			4764 a				
Control	2.8 a	73.5 a	4991 a	1.14 a	0.6 a	4492 a	73235 a
Fosetyl-Al	2.6 ab	67.1 a	3766 b	0 a	0.5 a	4855 a	77092 a
Ipridione	2.4 ab	51.4 b	3403 b	0.2 a	0.7 a	4220 a	73190 a
Benomyl	2.1 b	44.9 b		0 a	0.5 a	3176 b	54359 b
Mulching			4152 a				
Mulch	2.5 a	65.8 a	4311 a	0.02 a	0.5 a	4538 a	73757 a
No Mulch	2.4 a	52.5 b		0.1 a	0.6 a	3834 b	65181 a

* Vine health scored on a 0 to 5 relative scale where 0 = no vine death and 5 = greater than 81% of the vines dead.

** Crown and root rot scored on 0 to 5 relative scale where 0 = no crown or root rot and 5 = greater than 81% crown or root rotted.

*** Values followed by different letters within each factor is significantly different at *P* = 0.05 according to Fisher's Least Significant Test.

Discussion

Watermelon plants in the field treated with Aliette by any method of application were healthier and had less root rot than the controls. Since the spectrum of action for Aliette includes *Pythium* and *Phytophthora*, one of these fungi may be involved in MWVD. Pythium species are often isolated from MWVD affected watermelon vines. Therefore, Pythium spp. may be involved in MWVD.

In the greenhouse, Aliette was associated with significantly less root and crown rot when root rot symptoms were minor (Table 2). However, when root rot levels were higher, Aliette did not appear to control root rot or crown rot.

In all occasions when Rovral and Benlate were used, phytotoxicity interfered with efforts to compare these fungicides for the ability to control root rot caused by MWVD. It was observed, however, that little root or crown rot was associated with these two fungicides.